CLAIMS:

1. A method for effecting treatment in a patient comprising:

identifying a volume in the patient the whole of which volume is to be heated to a required temperature, the volume being defined by a peripheral surface of the volume;

providing a heat source and applying heat to the volume within the patient by;

providing the heat source on an invasive probe having a longitudinal axis and an end;

inserting the end of the probe into the volume;

arranging the probe to cause directing of heat from the end in a direction at an angle to the longitudinal axis such that a heating effect of the probe lies in a disk surrounding the axis;

arranging the direction of the heat so as to define a heating zone which forms a limited angular orientation of heating within the disk such that, as the probe is rotated, the probe causes heating of different angular segments of the volume within the disk;

with the probe at a fixed axial position, rotating the probe about the axis so that the heating zone lies in a selected segment;

wherein the application of heat by the probe to the selected segment causes heat to be transferred from the segment into parts of the volume outside the segment surrounding the end of the probe;

and applying cooling to the end of the probe so as to extract heat from the parts surrounding the probe by conduction of heat therefrom.

2. The method according to Claim 1 including arranging the amount of cooling to the probe relative to the heating such that the parts of the volume surrounding the end of the probe are cooled sufficiently to cause a net heating effect by which substantially only the segment of the heating zone is heated to the required temperature and the parts outside the segment are not heated to the required temperature.

3. The method according to Claim 2 wherein the cooling is arranged to maintain the parts outside the segment below a temperature sufficient to cause coagulation of the tissues therein.

4. The method according to Claim 1 including moving the end of the probe axially within the volume so as to move the disk of the heating effect axially within the volume from a first disk position to second disk position.

5. The method according to Claim 1 including the steps of:

operating a non-invasive detection system to generate a series of output signals over a period of time representative of temperature in the patient as the temperature of the patient changes during that time;

using the output signals to monitor at least one temperature of the volume as the temperature changes over the period of time;

wherein the temperature at the peripheral surface of the volume is monitored and a measure of the temperature of the segment at the peripheral

surface of the volume is used as the determining factor as to when to halt heating by the probe to the segment.

6. The method according to Claim 1 wherein the heat source comprises a laser, an optical fiber for communicating light from the laser and a light directing element at an end of the fiber for directing the light from the laser to the predetermined direction relative to the fiber and for forming the limited angular orientation within the disk.

7. The method according to Claim 1 wherein the end of the probe is cooled by:

providing on the probe a supply duct for a cooling fluid extending from a supply to the end of the probe;

providing an expansion zone of reduced pressure at the end of the probe so as to cause the cooling fluid to expand as a gas thus generating a cooling effect;

and providing on the probe a return duct for return of the expanded gas from the end of the probe.

8. The method according to Claim 7 wherein the temperature of the probe is cooled to a temperature in the range of about zero to about minus 20 degrees Celsius.

9. The method according to Claim 8 wherein the return duct is of larger cross-sectional area than the supply duct by a factor of the order of 200 to 250 times.

10. The method according to Claim 1 wherein the power of the heat source is reduced during heating of each segment from an initial high value to a lower value.

11. The method according to Claim 7 wherein the probe comprises an outer tube, wherein the supply duct is arranged inside the outer tube and wherein the return duct is defined by an inside surface of the outer tube.

12. The method according to Claim 11 wherein the supply duct is attached to an inside surface of the outer tube.

13. The method according to Claim 11 wherein the probe includes a heat energy supply conduit for transporting the heat energy from a supply to the end of the probe and wherein the heat energy supply conduit is attached to the inside surface of the outer tube.

14. The method according to Claim 7 wherein the cooling fluid is a gas which is expanded through a restricting orifice.

15. The method according to Claim 14 wherein the supply duct comprises a tube and the restricting orifice is formed by a reduced necking of the tube at an end thereof at the expansion zone.

16. The method according to Claim 15 wherein the probe includes an outer tube and the supply duct is mounted within the outer tube with the end thereof including the necking extending beyond an end of the outer tube.

17. The method according to Claim 9 wherein the heat source comprises a laser, an optical fiber for communicating light from the laser, and a light directing element at an end of the fiber, wherein the light directing element

comprises a chamfered end of the fiber and wherein the chamfered end is located in the gas in the expansion zone.

18. The method according to Claim 17 wherein the chamfered end is arranged at 45 degrees.

19. The method according to Claim 17 wherein the chamfered end carries a coating arranged to reflect light at two different wavelengths.

20. The method according to Claim 1 wherein there is provided a temperature sensor at the end of the probe.

21. The method according to Claim 12 wherein the probe comprises an outer tube and wherein there is provided a temperature sensor mounted on the inside surface of the tube at the end of the probe.

22. The method according to Claim 7 wherein the temperature at the end of the probe is controlled by varying the pressure in the fluid as supplied through the supply duct.

23. A method for effecting treatment in a patient comprising:

identifying a volume in the patient to be heated to a required temperature;

providing a heat source for applying heat to the volume within the patient,

providing a probe mounting the heat source allowing invasive insertion of an end of the probe into the patient,

providing a position control system for moving the end of the probe to a required position within the patient;

inserting the end of the probe into the volume;

providing on the probe a supply duct for a cooling fluid extending from a supply to the end of the probe;

providing an expansion zone of reduced pressure at the end of the probe so as to cause the cooling fluid to expand as a gas thus generating a cooling effect;

and providing on the probe a return duct for return of the expanded gas from the end of the probe.

24. The method according to Claim 23 wherein the temperature of the probe is cooled to a temperature in the range of about zero to about minus 20 degrees Celsius.

25. The method according to Claim 23 wherein the return duct is of larger cross-sectional area than the supply duct.

26. The method according to Claim 25 wherein the return duct is of the order of 200 to 250 times larger than the supply duct.

27. The method according to Claim 23 wherein the probe comprises an outer tube, wherein the supply duct is arranged inside the outer tube and wherein the return duct is defined by an inside surface of the outer tube.

28. The method according to Claim 27 wherein the supply duct is attached to an inside surface of the outer tube.

29. The method according to Claim 27 wherein the probe includes a heat energy supply conduit for transporting the heat energy from a supply to the end

of the probe and wherein the heat energy supply conduit is attached to the inside surface of the outer tube.

30. The method according to Claim 23 wherein the cooling fluid is a gas which is expanded through a restricting orifice.

31. The method according to Claim 30 wherein the supply duct comprises a tube and the restricting orifice is formed by a reduced necking of the tube at an end thereof at the expansion zone.

32. The method according to Claim 31 wherein the probe includes an outer tube and the supply duct is mounted within the outer tube with the end thereof including the necking extending beyond an end of the outer tube.

33. The method according to Claim 23 wherein the heat source comprises a laser, an optical fiber for communicating light from the laser, and a light directing element at an end of the fiber, wherein the light directing element comprises a chamfered end of the fiber and wherein the chamfered end is located in the gas in the expansion zone.

34. The method according to Claim 33 wherein the chamfered end is arranged at 45 degrees.

35. The method according to Claim 33 wherein the chamfered end carries a coating arranged to reflect light at two different wavelengths.

36. The method according to Claim 23 wherein there is provided a temperature sensor at the end of the probe.

37. The method according to Claim 23 wherein the probe comprises an outer tube and wherein there is provided a temperature sensor mounted on the inside surface of the outer tube at the end of the probe.

38. The method according to Claim 23 wherein the temperature at the end of the probe is controlled by varying the pressure in the cooling fluid as supplied through the supply duct.

39. The method according to Claim 23 wherein the heat source comprises a laser and an optical fiber for communicating light from the laser to the end of the probe, and wherein the probe includes an outer tube and a transparent capsule enclosing an end of the outer tube with the fiber extending to a position beyond the end of the tube into the capsule.

40. A probe for use in effecting treatment in a patient comprising:

a heat source for applying heat to a volume within the patient,

a probe body mounting the heat source thereon for allowing invasive insertion of an end of the probe into the patient,

a supply duct on the probe body for a cooling fluid extending from a supply to the end of the probe;

the probe body being arranged to provide an expansion zone of reduced pressure at the end of the probe body so as to cause the cooling fluid to expand as a gas thus generating a cooling effect;

and a return duct on the probe body for return of the expanded gas from the end of the probe.

41. The probe according to Claim 40 wherein the temperature of the probe is cooled to a temperature in the range of about zero to about minus 20 degrees Celsius.

42. The probe according to Claim 40 wherein the return duct is of larger cross-sectional area than the supply duct.

43. The probe according to Claim 42 wherein the return duct is of the order of 200 to 250 times larger than the supply duct.

44. The probe according to Claim 40 wherein the probe body comprises an outer tube, wherein the supply duct is arranged inside the outer tube and wherein the return duct is defined by an inside surface of the outer tube.

45. The probe according to Claim 44 wherein the supply duct is attached to an inside surface of the outer tube.

46. The probe according to Claim 44 wherein the outer tube includes a heat energy supply conduit for transporting the heat energy from a supply to the end of the probe and wherein the heat energy supply conduit is attached to the inside surface of the outer tube.

47. The probe according to Claim 40 wherein the cooling fluid is a gas which is expanded through a restricting orifice.

48. The probe according to Claim 47 wherein the supply duct comprises a supply tube and the restricting orifice is formed by a reduced necking of the supply tube at an end thereof at the expansion zone.

49. The probe according to Claim 40 wherein the probe body comprises an outer tube and the supply duct is mounted within the outer tube with the end thereof including the necking extending beyond an end of the outer tube.

50. The probe according to Claim 40 wherein the heat source comprises a laser, an optical fiber for communicating light from the laser, and a light directing element at an end of the fiber, wherein the light directing element comprises a chamfered end of the fiber and wherein the chamfered end is located in the gas in the expansion zone.

51. The probe according to Claim 50 wherein the chamfered end is arranged at 45 degrees.

52. The probe according to Claim 50 wherein the chamfered end carries a coating arranged to reflect light at two different wavelengths.

54. 53 The probe according to Claim 40 wherein there is provided a temperature sensor at the end of the probe.

54 55. The probe according to Claim 40 wherein the probe body comprises an outer tube and there is provided a temperature sensor mounted on the inside surface of the outer tube at the end of the probe.

55 56. The probe according to Claim 40 wherein the temperature at the end of the probe is controlled by varying the pressure in the cooling fluid as supplied through the supply duct.

56 57. The probe according to Claim 40 wherein the heat source comprises a laser and an optical fiber for communicating light from the laser to the end of the probe, and wherein the probe includes an outer tube and a transparent

capsule enclosing an end of the outer tube with the fiber extending to a position beyond the end of the outer tube into the capsule.